

## GENERATOR INSTALLATION

### ALL PHASES OF A GENERATOR INSTALLATION MUST BE INSTALLED BY ELECTRICIANS AND GASFITTERS LICENSED IN BALTIMORE COUNTY

#### GENERATOR SIZE

The first thing to establish when planning a generator installation is the size of the generator you will need.

Generators are rated in kilowatt output. If this output is exceeded by the load you put on the generator, the overcurrent device on the generator will trip and backup power will be lost.

Load calculations in accordance with the National Electric Code Article 220 can be performed to establish the size of your load so that you may establish what size generator you will need to supply sufficient power to that load.

Baltimore County requires a load calculation when automatic transfer generator set carries the entire load of the building service and the generator KW rating is lower than the service rating. *For example: A typical dwelling may be served by a 200 amp, 120/240 volt utility service (200 amp rating). This does not mean that the dwelling is using those 200 amps; it just means that 200 amps are available for use. A load calculation may show that the dwelling uses only 75 amps. By multiplying the calculated amps (75) by the available voltage (240) you will calculate a total load of 18000 watts (18KW). In such a case you would likely install a 20 KW generator.*

Keep in mind, however, that KW output of the generator must be reduced by 5% if you are using natural gas as the generators fuel source. *In the above installation; if a 20KW natural gas powered generator was selected; a reduction of 5% from the generators' output must be applied. (20000 watts x 5%= 1000 watts) The output of the generator must be reduced by 1000 watts. (20000w – 1000w= 19000 watts) A 20 KW generator would still be sufficient for the 18000 watt load even if natural gas was the fuel source.*

Some generator sets are equipped with load shedding capability. These devices turn off unnecessary loads such as air conditioners, dryers, etc. when the generator approaches its peak load output; but turn those loads back on when the total load on the generator is sufficiently reduced. This allows the exclusion of large loads such as air conditioners from the load calculation if they are controlled by the load shedding device, allowing more equipment to operate on a smaller generator by automatic regulation of the load. **PLEASE NOTE:** If the generator is loaded to the point where the frequency is diminished, sensitive electronic equipment such as PCs, televisions, even refrigerators could be adversely affected or possibly damaged!

In any event the inspectors may require a load calculation if they feel the load will exceed the generator output.

Load calculations are not required where manual (non-automatic) transfer switches are use

## **LOCATION**

The next thing to be considered when installing a generator is the location of the generator. This is important because of all the preparatory work that must be done prior to installation.

There are a few major factors to consider when determining location:

1. Proximity to the property line
2. Proximity to any buildings or structures
3. Proximity to openings in the building
4. Type of building construction
5. Required working clearances

In Baltimore County a generator must be 5' from a property line. This is required as a matter of safety for the neighbors of generator owners. Carbon monoxide poisoning has been a serious issue in the county. Keeping the generator 5' off the property line will allow the neighbors full use of their own property while safely limiting the possibility of CO gas poisoning.

NFPA 37 requires generators to be kept 5' from combustible construction. If the wall adjacent to the generator is of fire rated construction (at least 1 hour) there is no minimum distance requirement. Check the most recent U.L white book to determine the fire rating of walls.

There is only one (1) exception to this rule: If the generator's weatherproof housing has been demonstrated to contain a fire inside the enclosure, the generator's distance requirement from combustible construction may be reduced.

Baltimore County requires the demonstration of fire containment to be performed by a Nationally Recognized Testing Laboratory. Evidence of this is provided through factory placement of a sticker on the weatherproof housing bearing the Testing Laboratory's logo attesting to the enclosure's compliance with NFPA 37 for fire containment.

Regardless of generator placement, the point of exhaust MUST be kept 5' in any direction from any openings in a building such as doors, windows, vents, etc. Check the manufacturers' installation instructions for air-flow requirements around vegetation and other obstructions.

All working clearances must meet the minimum distances required by the National Electric Code. This includes the generator, disconnects, transfer switches, and any subpanels.

## **TRANSFER SWITCH**

The next step in a typical generator installation is the selection of the transfer switch. Issues to consider when selecting a transfer switch are:

1. Generator type (separately derived or non-separately derived system)
2. Load to be served (whole house or selected load)
3. Will the transfer switch require a modification of the utility service?
4. Will load shedding be needed?
5. Location of the transfer switch

The type of transfer switch must be compatible with the generator. If the generator is a separately derived system, the transfer switch must switch all ungrounded conductors and the grounded conductor of the feeder. ***Be very careful to assure that all conductors simultaneously transfer.*** If the grounded conductor is opened while the ungrounded conductors are energized and connected to a load, a voltage spike will occur and likely cause damage to the connected loads.

If the generator is not a separately derived system only the ungrounded conductors of the feeder are required to be switched.

A separately derived system is one in which the grounded conductor of the generator is bonded to the frame of the generator.

Typically, *generator sets* are non-separately derived systems. Most *portable generators* are separately derived systems. Check your manufacturer's instructions.

If you are selecting a whole house transfer system you will likely need to modify the utility service. Your service disconnect may be part of the transfer switch. All modifications to the service must comply with the National Electric Code, and must be noted on the permit application. All changes made to the existing wiring must comply with the National Electric Code.

If you choose to modify only part of the service by using a transfer switch as a service disconnect for a selected load and still have a other utility service disconnects that are not going to be transferred; note that the National Electric Code requires all service disconnects to be grouped in one location.

If you are installing a system which transfers only selected loads, be sure to use the same type of breaker for the selected circuit that was originally used for that circuit (arc-fault, ground-fault, etc.).

You cannot select to transfer only part of a multi-wire circuit. The entire multi-wire circuit must be selected (or not). The National Electric Code requires that the ungrounded conductors of a multi-wire circuit be simultaneously disconnected when tripped. This cannot be achieved with the ungrounded conductors in separate panels.

If you choose to use load shedding, check with the manufacturer to be sure that the system you select has that capability.

The transfer switch for a manual transfer system must simultaneously connect the standby source while disconnecting the utility power.

## WIRING REQUIREMENTS

Article 725 of the National Electric Code states that; only Class 1 signal and control wiring associated with the load served by the feeder from the generator is permitted to share a raceway with that feeder. The Class 2 and 3 control circuits are associated with the load served by the feeder because they are used to connect the load to the feeder, but they are not permitted in the feeder raceway unless they are re-classified as Class 1 circuits. You may reclassify the Class 2 or 3 control circuits as Class 1 circuits and install them in the raceway with the feeder.

The signaling wire that notifies the generator when utility power is energized or de-energized must be installed in a separate raceway or as a cable external to the raceway as it has no association with the load served by the feeder. It is used only to let the generator know when to turn on or off. The load will be served regardless of whether the signaling wire is energized or de-energized.

## DISCONNECTING MEANS

The required disconnecting means for each generator system will vary according to the installation method, manufacturer, type of transfer switch, location of the generator, etc. It is important to remember these rules:

1. The generator must have a disconnecting means. This disconnect separates the generator from the feeder. It must be lockable in the open position. Generally, if the generator is part of an optional standby system operating on its own; a disconnecting means would not be required if the driving means for the generator can be readily shut down.
2. The feeder must also have a disconnecting means. This disconnect separates the feeder from the load it serves. It must be readily accessible, suitable for use as service, and be located either immediately outside the structure or load being served, or immediately inside where the feeder enters the structure.

If the generator has a disconnect that is rated as being suitable for use as service, is readily accessible, is within 50' of the structure or load being served, and is within sight of the structure or load being served; that disconnect may also serve as the disconnecting means for the feeder.

Check with your inspector. Many generators indicate that the overcurrent device is 'service rated'. This is not the same as 'suitable for use as service'.

Some transfer switches are equipped with feeder disconnects, some are not. This depends on the conditions of use, the manufacturer of the transfer switch, and the location of the transfer switch.

Each disconnect must comply with the working clearances required in Article 110 of the National Electric Code.

For portable generator installations the plug connection is considered the required disconnecting means for the generator. This does not preclude the requirement that the manual transfer switch simultaneously connects the standby source while disconnecting the utility power.

## **SIGNAGE**

In accordance with the National Electric Code:

702.7 “A sign shall be placed at the service entrance equipment that indicates the type and location of on-site optional standby power sources.”

**702.7(B)** If the installation involves a non-separately-derived generator, special precautions must be observed. The grounded conductor from the utility service and from the generator will both be bonded to the service panel and to the grounding electrode conductor. If the bonding jumper or the grounding electrode conductor is disconnected or removed while the generator is running there is a possibility for a shock hazard.

**702.7(B)** “....a warning sign shall be installed at the normal power source equipment stating: WARNING SHOCK HAZARD EXISTS IF GROUNDING ELECTRODE CONDUCTOR OR BONDING JUMPER CONNECTION IN THIS EQUIPMENT IS REMOVED WHILE ALTERNATE SOURCE(S) IS ENERGIZED”

110.22(A) “Each disconnecting means shall be legibly marked to indicate its purpose unless located and arranged so the purpose is evident. The marking shall be of sufficient durability to withstand the environment involved”

In accordance with the Baltimore County Building Code Part 128.1.3; “All required signs, labels, markings, etc. shall be permanently affixed and shall be suitable for the environment encountered.”

## **PORTABLE GENERATORS**

When installing a portable generator there are additional precautions to be considered.

Unlike generator sets, not all portable generators are equipped with voltage or frequency stabilizers. These stabilizers allow electronic equipment to operate within an acceptable range of voltage or frequency fluctuation.

Without these stabilizers electronic equipment such as televisions, refrigerators, or PCs could be damaged when connected to the portable generator if the voltage or frequency should spike or dip significantly.

It is also important to consider that many portable generators employ separately derived systems. This means that the grounded conductor (sometimes called the neutral conductor) may be bonded to the frame of the generator.

This is important to note because:

1. When connected through a transfer switch, the grounded conductor carries the unbalanced current.
2. The type of transfer switch MUST match the type of generator...if the generator is a separately derived system, the transfer switch must switch ALL the circuit conductors. Failure to provide the proper transfer switch could result in objectionable current all along the grounding paths of the entire load. This means that the metal surfaces that are normally grounded may become current carrying surfaces. Under certain conditions there could be a difference of potential between the earth and the energized surface; posing a shock hazard.
3. If the generator is NOT a separately derived system and the wrong type of transfer switch is used, there will be no return path for clearing a ground fault. The grounding conductors would be connected to the utility's grounded (neutral) conductor but would have no connection to the generator's grounded conductor. In a ground fault situation, the grounding conductor would simply carry a voltage to ground and, having no path back to the source, have no ability to facilitate tripping an overcurrent device and create a possible shock hazard.
4. If the path designed to carry ground faults back to the grounded conductor to facilitate tripping the overcurrent device is carrying a current, GFCIs will not operate properly.

**BACKFEEDING THE BUILDING THROUGH DRYER PLUGS OR SIMILAR MEANS WITHOUT THE USE OF AN APPROVED TRANSFER SWITCH IS EXTREMELY DANGEROUS AND COULD RESULT IN INJURY OR DEATH TO UTILITY WORKERS**

## **2012 BALTIMORE COUNTY BUILDING CODE REQUIREMENTS FOR GENERATORS**

**PART 128.12 GENERATORS.** ALL GENERATORS SHALL COMPLY WITH THIS CODE AS WELL AS PROVISIONS OF NFPA 37 STANDARD FOR THE INSTALLATION AND USE OF STATIONARY COMBUSTION ENGINES AND GAS TURBINES, 2010 EDITION; AND NFPA 110 STANDARD FOR EMERGENCY AND STANDBY POWER SYSTEMS, 2010 EDITION. INSTALLATION AND USE SHALL BE IN ACCORDANCE WITH THE MANUFACTURER'S INSTRUCTIONS.

**PART 128.12.1 PROPERTY LINE SETBACK.** ALL GENERATORS SHALL BE SO POSITIONED AS TO BE A MINIMUM OF 5 FEET FROM A PROPERTY LINE

**PART 128.12.2 GENERATOR EXHAUST.** ALL GENERATORS SHALL BE POSITIONED SO THAT THE EXHAUST IS DIRECTED AS FOLLOWS:

- A. AT LEAST 5 FT IN ANY DIRECTION AWAY FROM ANY OPENINGS OR AIR INTAKES.
- B. POINT OF EXHAUST DISCHARGE MUST BE COMPLIANT WITH MANUFACTURERS RECOMMENDATIONS
- C. AT LEAST 5 FT AWAY FROM A PROPERTY LINE.

**PART 128.13 PORTABLE GENERATORS.** THE FOLLOWING REQUIREMENTS GOVERN THE USE OF PORTABLE GENERATORS:

1. PORTABLE GENERATORS SHALL NOT BE OPERATED OR REFUELED WITHIN BUILDINGS, PORCHES, BALCONIES, OR ON ROOFS.
2. FUELING FROM A CONTAINER SHALL ONLY BE PERMITTED WHEN THE ENGINE IS SHUT DOWN AND ENGINE SURFACE TEMPERATURE IS BELOW THE AUTOIGNITION TEMPERATURE OF THE FUEL.
3. A PORTABLE GENERATOR SHALL BE ALLOWED TO BE UTILIZED AS A SOURCE OF POWER FOR A MAXIMUM OF 30 DAYS IN ANY CONSECUTIVE 12-MONTH PERIOD.
4. TEMPORARY WIRING METHODS MAY BE ACCEPTABLE ONLY IF APPROVED BASED ON THE CONDITIONS OF USE. EXCEPT AS MAY BE SPECIFICALLY MODIFIED IN NFPA 70, ALL OTHER REQUIREMENTS OF NFPA 70 FOR PERMANENT WIRING SHALL APPLY TO TEMPORARY WIRING INSTALLATIONS.
5. EXTENSION CORD AND FLEXIBLE CORDS SHALL NOT BE AFFIXED TO STRUCTURES; EXTEND THROUGH WALLS, CEILINGS, OR FLOORS, OR UNDER DOORS OR FLOOR COVERINGS; OR BE SUBJECT TO ENVIRONMENTAL OR PHYSICAL DAMAGE AND, UNLESS SPECIFICALLY PERMITTED IN ARTICLE 400.7 OF NFPA 70, FLEXIBLE CORDS AND CABLES SHALL NOT BE USED AS A SUBSTITUTE FOR THE FIXED WIRING OF A STRUCTURE.
6. DEVIATIONS FROM REQUIREMENTS 1 AND 4 ABOVE DURING PERIODS OF 3 CONSTRUCTION, REMODELING, REPAIR OR DEMOLITION UNDER A VALID BUILDING PERMIT SHALL BE SUBJECT TO THE APPROVAL OF THE CODE OFFICIAL.